REMARKS/ARGUMENTS

No amendment is made in the present response. Claims 1-4, 6-11, and 13-21 are pending. Reconsideration of the present application in view of the following remarks is respectfully requested.

Claim Rejections under 35 U.S.C. § 112, First Paragraph

Claims 13-17 and 21 are rejected under 35 U.S.C. § 112, first paragraph, because the Examiner deems that "a catalyst bed voidages [sic, voidage] of .35 to .45 is critical or essential to the practice of the invention, but not included in the claim(s). . . ." (See page 2 of the Office Action.) In response, Applicants read the present application carefully, and find that the description of "a catalyst bed voidage of 0.35 to 0.45" only appears once in the Background section of the present application as follows:

> Indeed, in industrial gas-liquid countercurrent hydrogenating reactors, the catalyst is used as sphere or cylinder with a diameter less than 3 mm, and is loaded at a catalyst bed voidage of 0.35 to 0.45, much lower than the voidage for conventional countercurrent operations (>0.95). However, at such a catalyst bed voidage, the countercurrent reactors tends to cause flooding and an unstable operation of the plant.

Applicants do not find that the above description suggests that a catalyst bed voidage of 0.35 to 0.45 is critical to the practice of the present invention. Nor do Applicants find any other description in the specification suggesting that "a catalyst bed voidage of 0.35 to 0.45" is essential or critical to the practice of the present invention. Hence, Applicants respectfully request that the Examiner withdraw the rejections under 35 U.S.C. § 112, first paragraph. If upon considering the above comments, the Examiner, however, still maintains his rejections under 35 U.S.C. § 112, first paragraph, Applicants respectfully request that the Examiner provide a detailed explanation.

Rejection of Claims 1-11 under 35 U.S.C. § 103 from Gao in Combination with Imai

Claims 1-11 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Gao et al. (U.S. Patent No. 6,117,812) in view of Imai et al. (U.S. Patent N0. 5,043,509). (See pages 3-5 of the Office Action.)

Applicants respectfully disagree.

First, Gao and Imai, taken individually or together, fail to teach or suggest all of the limitations of claim 1. See MPEP 2143.03 ("All Claim Limitations Must Be Taught or Suggested.") (Emphasis added.) Claim 1 provides a process for carrying out gas-liquid countercurrent processing, comprising passing the liquid material and the gas reactant in countercurrent flow through the fixed bed of catalyst in a reactor, wherein the fixed bed of catalyst includes two or more catalyst layers, with the difference of voidages between the adjacent catalyst layers being at least 0.05. In other words, according to claim 1, there must be at least two different catalysts with different voidages, respectively placed in a fixed bed reactor at different layers, and the two adjacent catalyst layers must differ from each other in voidage by at least 0.05.

Gao discloses catalysts having special shapes, i.e., a window-lattice or a star shape, which can be loaded at random directly into the catalytic distillation column (see, e.g., col. 3, lines 14-34; col. 4, lines 1-30). The Examiner acknowledges that Gao fails to teach at least two catalyst layers with different voidages in a fixed-bed reactor or the difference of the adjacent catalyst layers in vodiage.

Nor does Imai disclose at least two catalyst layers with different voidages in a fixed-bed reactor or the difference of the adjacent catalyst layers in vodiage. Imai discloses catalyst particles which provide a sufficient amount of voidage to enable any expansion of the catalyst particles without excessive loss of voidage and thereby allow a concurrent stability of pressure to be maintained (see, e.g., col. 1, line 65 to col. 2, line 7). As shown in Tables 3-4 of cols. 11-12, the larger the voidage of catalyst bed layers is, the smaller the increase of the pressure drop of said catalyst bed layers as time goes by. Based on the data of Tables 3-4 of cols. 11-12, Imai concludes that catalyst particles in quadralobe or tubular cylindrical shape will maintain a sufficient amount of voidage to permit passage of the feed over the catalyst without resulting in an unacceptable pressure drop, whereas the catalyst particles in solid cylinder, ridged, fluted, or channeled cylindrical shape will cause a pressure drop rendering the process inoperable (see, col. 12, line 63 to col. 13, line 20). Nowhere does Imai teach or suggest the use of at least two catalysts in one fixed bed reactor, not to mention placing the at least two catalysts at different layers and making sure the adjacent catalyst layers differ from each other in vodiage by at least 0.05.

Indeed, Imai consistently discloses that only one catalyst uniformly in one voidage (or shape) is used in a reactor. See e.g., col. 3, lines 26-30 ("By utilizing a catalyst which possesses a shaped form such as a polylobular configuration it is possible to effect a process in such a manner whereby the possibility of a disadvantageous pressure drop occurring is greatly diminished."); col. 12, lines 27-28 ("[W]hen utilized as a catalyst in a reactor the catalyst particles will possesses a voidage according to the following table."); col. 12, lines 64-65 ("catalyst particles which possess a quardarlobe or tubular cylindrical shape"); col. 13, lines 15-20 ("It is therefore readily apparent from the above calculations that the use of catalyst particles which posses a desired configuration will permit a sufficient amount of voidage to be maintained during the operation when compared to catalyst particles, which have heretofore been employed in this type of reaction." (Emphasis added.)

As acknowledged by the Examiner, Imai teaches that a catalyst layer in lower voidage may be used to prevent an excessive pressure drop in the reactor. However, nowhere does Imai suggest that the use of at least two catalyst layers in different voidages can prevent the excessive pressure drop or have any other benefit. Of course, without being advised of any benefit a person of ordinary skill in the art would not use at least two catalyst layers in different voidages, because doing so will render the operation more complicated (e.g., loading at least two different types of catalyst in the reactor at different layers) and probably increase the cost due to the use of different catalysts indifferent voidages.

Upon considering the above explanation, if the Examiner, however, still insists that the prior art of record teaches "two or more catalyst layers in a fixed bed of reactor with the difference of voidages between the adjacent catalyst layers being at least 0.05", Applicants respectfully request that the Examiner specifically identify such teachings in the cited art, not from the present application itself.

Second, a person of ordinary skill in the art would not modify Gao's process based on Imai's teaching to arrive at the present invention. See MPEP 2143.01 ("THE PRIOR ART MUST SUGGEST THE DESIRABILITY OF THE CLAIMED INVENTION.") Rather, the cited art teaches away from the present invention. Imai discloses a process where the reactants flow in the same direction (see, e.g., col. 9, lines 17-21). Hence, Imai at best pertains to a gas liquid concurrent process, where excessive pressure drop is a major concern for long term operation of the process. In contrast, as the Examiner correctly recognizes, Gao discloses a countercurrent process where the vapor stream flows upward and the liquid stream passes downward through the catalyst bed. In such a concurrent process, the vapor stream flowing upward agitates the mixture of the liquid flowing downward and the catalyst and hence does not form a "solid bed" (see col. 1, line 55 to col. 2, line 6 of Imai), causing an excessive pressure drop. As the agitation creates more space among the catalyst particles, unlike concurrent process, countercurrent process typically does not have the problem of excessive pressure drop. Therefore, a person of ordinary skill in the art would not be motivated to modify Gao's countercurrent process by using Imai's catalyst to diminish excessive pressure drop.

In fact, even if a person of ordinary skill in the art would be motivated to combine the teachings of Imai and Gao, as the Examiner suggests, this person would only use one type of catalyst in an uniform shape, such as tubular cylinder, in Gao's process to reduce the excessive pressure drop along the catalyst bed. As noted above, for simplification of operation and potential lowering of cost, a person of ordinary skill in the art would not use at least two different types of catalyst in different voidages and load them sequentially in a reactor as different catalyst layers, not to mention making sure that the adjacent layers differ from each other in voidage by at least 0.05.

Moreover, at col. 3, lines 21-33 and col. 4, lines 13-28, Gao discloses,

> The catalytic distillation technique of the present invention is devised to make the active substance of the catalyst or the catalyst carrier into one having large external surface area and high strength, capable of being moulded into a given shape easily, and when packed at random into the catalytic reaction section of the catalytic distillation column, there will be adequate voidage inside the catalyst pellets and therebetween to meet the requirement for countercurrent flow of both vapor and liquid phases. . . .
>
> * * *
>
> Both the aforesaid two shapes of the dual functional catalyst can be loaded at random directly through the catalyst inlet into the reaction section of the catalytic distillation equipment, and the used deactivated catalyst can also be unloaded directly from the catalyst outlet without having worker enter the column to load and unload catalyst, thus preventing human body from any harm in the residues in the column, and it is convenient to operate and low in operation cost. But in the prior art the catalyst made into regular packings in ripple or beehive shape, requires that the fresh catalyst must be placed one by one manually in the column, and the deactivated catalyst also must be removed in the same manner, such

> operation is not only consumptive in time, labour and cost, but also harmful to workers who may be poisoned by the residue materials when working for a long period inside the column.

(Emphasis added.)

The above statements suggest that Gao does not disclose or suggest the use of two catalysts in different voidages in one reactor. Rather, Gao discourages the use of multiple catalyst layers with different vodiages when Gao criticizes placing the catalyst(s) in the reactor in order. Hence, Gao teaches away the use of catalysts in different vodiages loaded as different layers of one reactor.

Third, unexpected results are obtained in the present invention. See MPEP716.02 ("GREATER THAN EXPECTED RESULTS ARE EVIDENCE OF NONOBVIOUSNESS.") As explained in the specification in detail, in a gas-liquid countercurrent process, the gas and liquid phases undergo constant changes in volume and viscosity respectively, which have an important influence on the operating stability of the plant. An evenly distributed catalyst bed is used in the prior art, without considering the change of gas-liquid ratios at different sections of the reactors, and thus fails to improve the comprehensive operating flexibility and stability. One typical problem incurred from the use of evenly distributed catalyst in a gas-liquid countercurrent process is that flooding occurs at either upper section or lower section of the reactor, depending on the nature of the reaction. See paragraphs 0010 and 0020, etc. To prevent flooding in the fixed bed of the reactor, Applicants developed a process for carrying out gas-liquid countercurrent processing in a fixed bed of catalyst, which includes two or more catalyst layers, with the difference of voidages between the adjacent catalyst layers being at least 0.05 (see, e.g. 1). In addition, the present invention has other advantages, such as improvement of the product quality, catalyst life, flexibility and stability of operation, etc.

See, e.g., paragraphs 0020 and 0032-0046. None of these advantages is disclosed or taught in Imai or Gao.

For at least the above reasons, Applicants believe that claim 1 is not obvious under 35 U.S.C. § 103(a) as being unpatentable over Gao in view of Imai. For at least the same reasons, claims 2-4, and 6-11, all of which depend from claim 1, are also not obvious under 35 U.S.C. § 103(a) as being unpatentable over Gao in view of Imai.

In addition, the following reasons further support that none of claims 2-4 and 6-11 is obvious under 35 U.S.C. § 103(a) as being unpatentable over Gao in view of Imai. For example, neither Gao nor Imai teaches the limitations of "2 to 10 catalyst layers" (claim 2); "the difference of the voidages between the adjacent catalyst layers is 0.05 to 0.065 or 0.10-0.40 (claims 3-4); "at least one low-voidage catalyst with a voidage of 0.25-0.55 (or 0.30-0.50) and at least one high-voidage catalyst with a voidage of 0.35-0.90 (0.45-0.80)" (claims 6-11).

We note that the Examiner comments, "where the general conditions of the claims are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." Applicants believe that this statement is not applicable here.

First, because there are no general conditions disclosed in the art of record such as "at least two catalyst layers in a reactor with different voidages", the prior art of record provides neither a broad range nor an overlapping range from which a person of ordinary skill in the art could optimize. To apply the stated rule, the Examiner must identify a general disclosure in the prior art (i.e., a broad range encompassing the claimed narrow range or a range overlapping the clamed range) from which a person of ordinary skill in the art would have optimized. Nevertheless, the Examiner does not identify such pertinent general disclosure in the prior art.

Second, please note that under MPEP2144.05 (II)(B), "Only Result-Effective Variables Can Be Optimized." Here, as noted above, the art of record fails to recognize the importance of using "at least two catalyst layers with different voidages" for preventing flooding or any other beneficial use. In other words, the prior art of record does not recognize the "at least two catalyst layers with different voidages" as a "result-effective variable". Hence, a person of ordinary skill in the art would not optimize the art of record to arrive at the present invention, as the Examiner proposes.

Third, "Applicants can rebut a *prima facie* case of obviousness based on overlapping ranges by showing the criticality of the claimed range." See MPEP2144.05 (III). As noted above, the specification specifically shows that "the at least two different catalyst layers in different voidages" and the specific difference between two adjacent catalyst layers in voidage are critical for solving the problem of e.g., flooding of a countercurrent gas liquid process.

Therefore, if upon considering the above explanation, if the Examiner still maintains his position with respect to claims 2-4 and 5-11, Applicants respectfully request that the Examiner provide a detail explanation with respect to each of the dependent claims, rather than a general assertion that they are obvious optimization of the prior art range.

Rejection of Claims 1-4, 6-11, and 13-17 under 35 U.S.C. § 103 (a) from Harrison in Combination with Imai

Claims 1-4, 6-11, 13-17, and 21 remain rejected under 35 U.S.C. 103(a) as being unpatentable over Harrison et al. (U.S. Patent No. 5,252,198) in view of Imai as applied above to claims 1-4, and 6-11.

Applicants disagree.

Harrison discloses a countercurrent hydrodesulphrisation process and hence may be potentially more relevant to claims 13-17 and 21, which are directed to a hydrotreating process, than is Gao. Other than that, Harrison fails to provide any pertinent disclosure beyond Gao. Therefore, the reasons discussed above are equally applicable to the rejections of claims 1-4, 6-11, 13-17, and 21 under 35 U.S.C. 103(a) over Harrison in view of Imai.

First, Harrison and Imai, taken individually or together, fail to teach or suggest all of the limitations of claim 1. See MPEP 2143.03 ("All Claim Limitations Must Be Taught or Suggested.") (Emphasis added.) Claim 1 provides a process for carrying out gas-liquid countercurrent processing, comprising passing the liquid material and the gas reactant in countercurrent flow through the fixed bed of catalyst in a reactor, wherein the fixed bed of catalyst includes two or more catalyst layers, with the difference of voidages between the adjacent catalyst layers being at least 0.05. Likewise, the other independent claim 21 also recites a gas-liquid countercurrent process. The process comprises passing diesel oil distillate and hydrogen in countercurrent flow through a fixed bed of hydrotreating catalyst in a reactor. The fixed bed of catalyst includes at least two catalyst layers, and the voidage of the at least two catalyst layers decreases in the direction of the flow of the diesel oil distillate, with the difference of voidage between the adjacent catalyst layers being at least 0.05. In other words, according to either claim 1 or claim 21, there must be at least two different types of catalysts with different voidages, respectively placed in a fixed bed reactor at different layers, and the two adjacent catalyst layers must differ from each other in voidage by at least 0.05. Claim 21 additionally requires that that at least two catalyst layers decreases in the direction of the flow of the diesel oil distillate.

The Examiner acknowledges that Harrison fails to teach at least two catalyst layers with different voidages in a fixed-bed reactor or the difference of the adjacent catalyst layers in vodiage.

As noted above in connection with the rejections of claims from Gao in combination with Imai, nor does Imai disclose at least two catalyst layers with different voidages in a fixed-bed reactor or the difference of the adjacent catalyst layers in vodiage.

Second, a person of ordinary skill in the art would not modify Harrison's process based on Imai's teaching to arrive at the present invention. See MPEP 2143.01 ("THE PRIOR ART MUST SUGGEST THE DESIRABILITY OF THE CLAIMED INVENTION.") As noted above, Imai discloses a process where the reactants flow in the same direction (see, e.g., col. 9, lines 17-21), and pressure drop is a major concern for long term operation of the process. In contrast, as the Examiner correctly recognizes, Harrison discloses a countercurrent process where the vapor stream flows upward and the liquid stream passes downward through the catalyst bed. As noted above, such a concurrent process typically does not have a problem of excessive pressure drop, because the gas flowing upward agitates the liquid mixture flowing downward and the catalyst, creating more space among catalyst particles. See, e.g., the Abstract of Harrison ("[G]as upcomer means associated with each reaction tray adapted to allow gas to enter that tray from below and to agitate the mixture of liquid and catalyst on that tray.") (Emphasis supplied.) Therefore, a person of ordinary skill in the art would not be motivated to modify Harrison countercurrent process by using Imai's catalyst to diminish excessive pressure drop.

As noted above, even if a person of ordinary skill in the art would be motivated to combine the teachings of Imai and Harrison, as the Examiner suggested, this person would only use one type of catalyst in an uniform shape, such as tubular cylinder, in Harrison's process to reduce the excessive pressure drop along the catalyst bed. For simplification of operation and potential lowering of cost, a person of ordinary skill in the art would not use at least two different types of catalyst in different voidages or shapes and load them sequentially in a reactor as different layers, not to mention making sure that the adjacent layers differ from each other in voidage by at least 0.05.

Moreover, Harrison uses a column reactor. As seen from Fig. 1, there are multilayers of trays in the reactor as well as such complicated structures as spargers (reference number 4) and downcomers (reference number 8) for the flow and distribution of gas and liquid. The catalyst particles are loaded onto the reaction trays. Harrison does not disclose the use of a fixed bed reactor as is recited in the claims of the present application. Hence, even if a person of ordinary skill in the art would use Imai's catalyst in Harrison's process using a column reactor, this person would still not arrive at the present invention using a fixed bed reactor.

Third, unexpected results are obtained in the present invention. See MPEP716.02 ("GREATER THAN EXPECTED RESULTS ARE EVIDENCE OF NONOBVIOUSNESS.") As explained in the specification in detail, in a gas-liquid countercurrent process, the gas and liquid phases undergo constant changes in volume and viscosity respectively, which have an important influence on the operating stability of the plant. An evenly distributed catalyst bed is used in the prior art, without considering the change of gas-liquid ratios at different sections of the reactors, and thus fails to improve the comprehensive operating flexibility and stability. One typical problem incurred from the use of evenly distributed catalyst in a gas-liquid countercurrent process is that flooding occurs at either upper section or lower section of the reactor, depending on the nature of the reaction. See paragraphs 0010 and 0020, etc. To prevent flooding in the fixed bed of the reactor, Applicants developed a process for carrying out gas-liquid countercurrent processing in a fixed bed of catalyst, which includes two or more catalyst layers, with the difference of voidages between the adjacent catalyst layers being at least 0.05 (see, e.g. claims 1 and 21). In addition, the present invention has other advantages, such as improvement of product quality, catalyst life, operation flexibility, and operation stability, etc. See, e.g., paragraphs 0020 and 0032-0046. None of these advantages is disclosed or taught in Harrison or Imai.

For at least the above reasons, Applicants believe that neither claim 1 nor claim 21 is obvious under 35 U.S.C. § 103(a) as being unpatentable over Harrison in view of Imai. For at least the same reasons, claims 2-4, 6-11, and 13-17, each which depends from either claim 1 or claim 21, are also not obvious under 35 U.S.C. § 103(a) as being unpatentable over Harrison in view of Imai.

In addition, the following reasons further support that none of claims 2-4,6-11, and 13-17 is obvious under 35 U.S.C. § 103(a) as being unpatentable over Harrison in view of Imai. For example, none of the art of record teaches the limitations of "2 to 10 catalyst layers" (claim 2), "the difference of the voidages between the adjacent catalyst layers is 0.05 to 0.065 or 0.10-0.40 (claims 3-4); "at least one low-voidage catalyst with a voidage of 0.25-0.55 (or 0.30-0.50) and at least one high-voidage catalyst with a voidage of 0.35-0.90 (0.45-0.80)" (claims 6-11); "the percentage of low voidage catalyst" (claims 13-14); the use of noble metal catalyst as low voidage catalyst and the use of hydrorefining catalyst as high voidage catalyst" (claims 15-16) .

As noted above, Applicants do not believe that the Examiner correctly applies the rule of "optimization from general conditions" here.

First, because there are no general conditions disclosed in Imai or Harrison such as "at least two catalyst layers in a reactor with different voidages" or any percentage of low voidage of catalyst, the cited prior art provides neither a broad range nor an overlapping range from which a person of ordinary skill in the art can optimize.

Second, please note under MPEP2144.05 (II)(B), "Only Result-Effective Variables Can Be Optimized." Here, as noted above, the art of record fails to recognize the importance of using "at least two catalyst layers with different voidages" or any percentage of low voidage catalyst for preventing flooding or any other beneficial use. Because the prior art of record does not recognize the "at least two catalyst layers with different voidages" as a "result-effective variable", a person of ordinary skill in the art would not optimize the art of record to arrive at the present invention as the Examiner proposes.

Third, "Applicants can rebut a *prima facie* case of obviousness based on overlapping ranges by showing the criticality of the claimed range." See MPEP2144.05 (III). As noted above, the specification has specifically shows that "the at least two different catalyst layers in different voidages" and the specific difference between two adjacent catalyst layers in voidage are critical for solving the problem of, e.g., flooding of a liquid gas countercurrent process.

If upon considering the above explanation, the Examiner still maintains his position with respect to claims 2-4, 5-11, and 13-17, Applicants respectfully request that the Examiner provide a detail explanation with respect to each of the dependent claims, rather than a general assertion that they are obvious optimization of a general disclosure in the prior art.

Based on the foregoing, Applicants believe that the present application is in condition of allowance. Early and favorable consideration is earnestly requested.

It is believed that no fees or charges are required at this time in connection with the present application. However, if any fees or charges are required at this time, they may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,
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